The Two-Wavelength Satellite Laser Ranging Experiment at Shanghai Station

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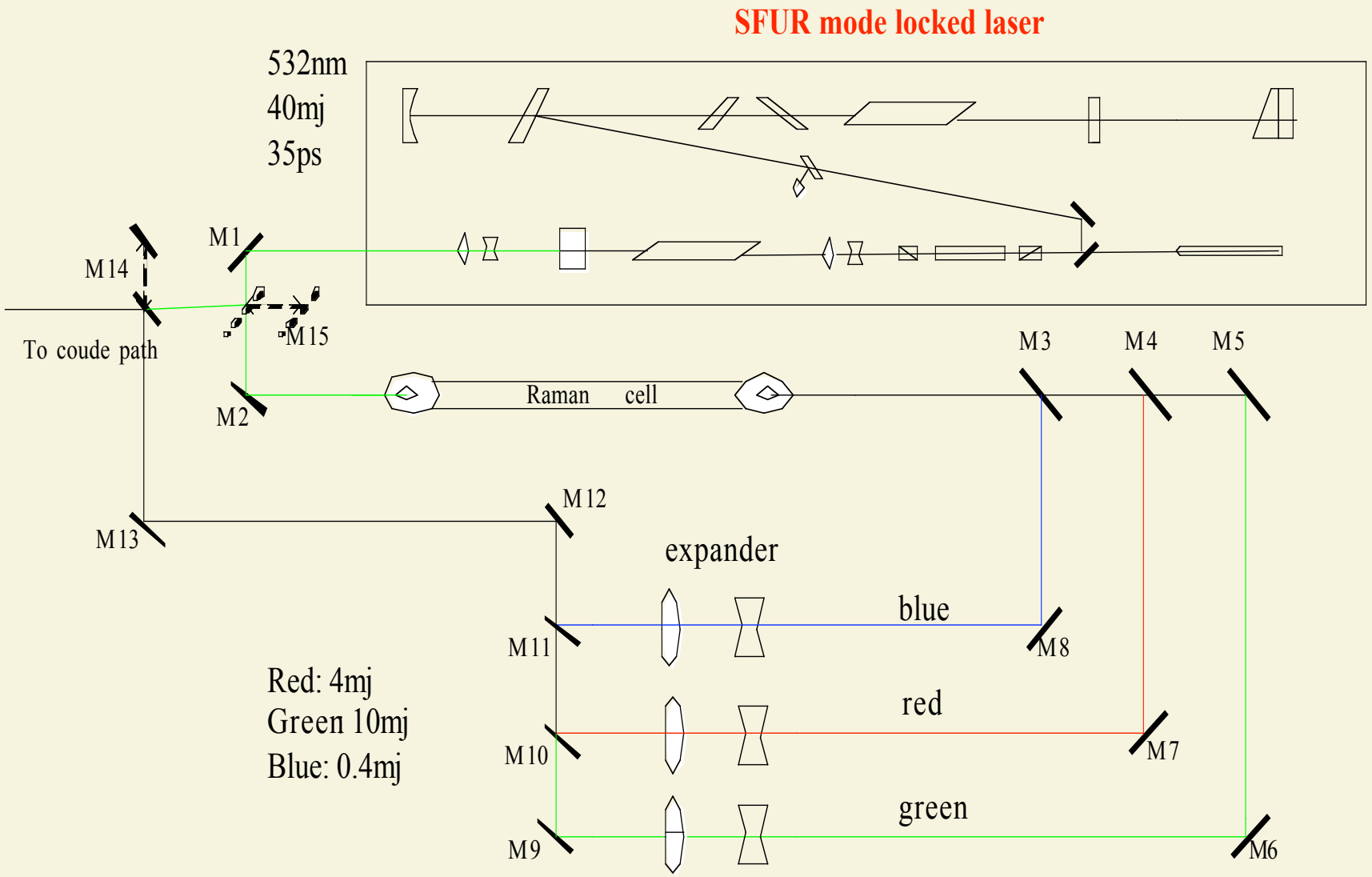
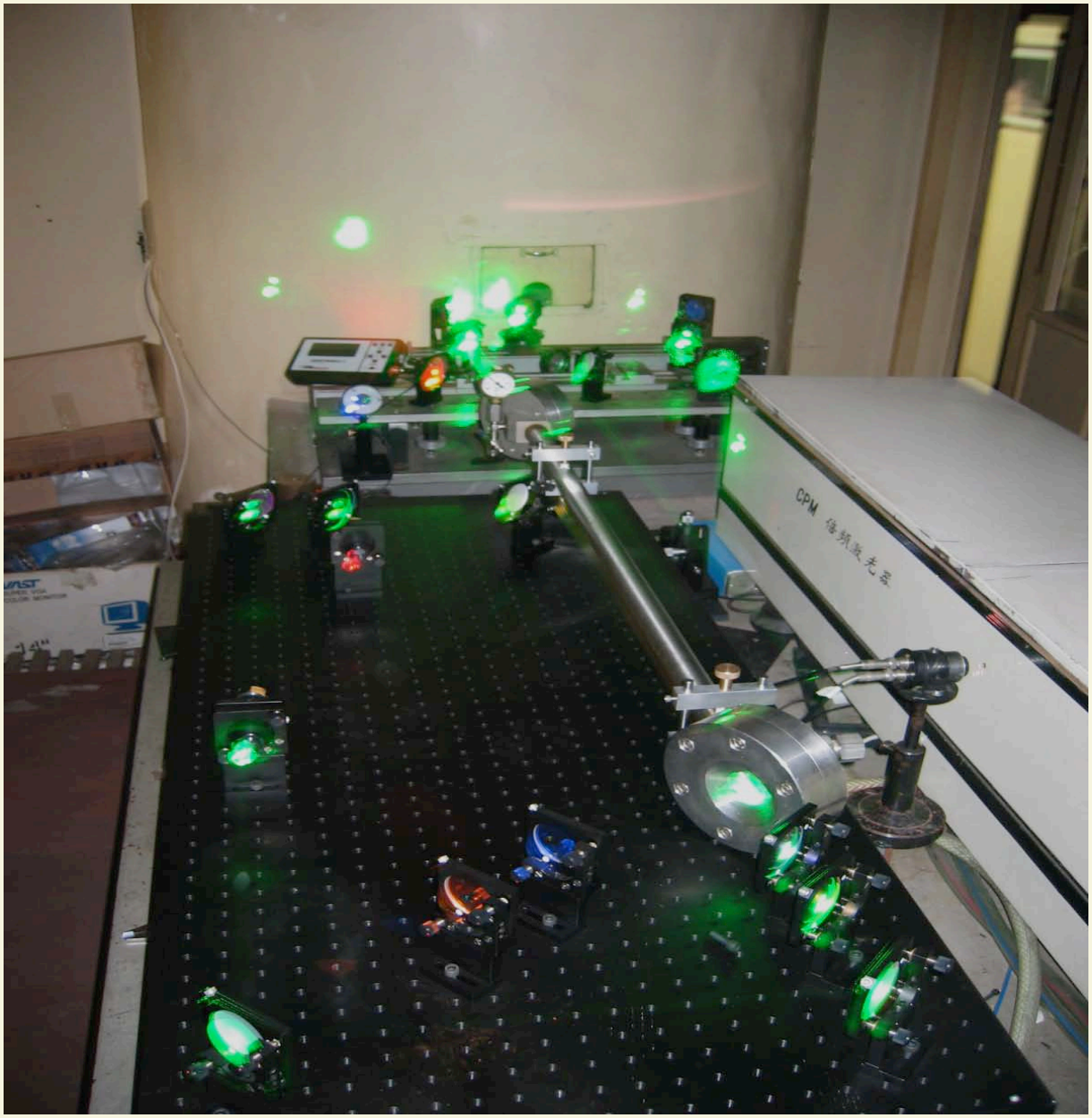
- **Several years ago, we were pleased to get a Raman cell from Dr. Gaignebet**
- **Two years ago, we cooperated well with Czech Technical University in researching the conversion efficiency of the Raman laser.**
- **Last year, we set up the two-wavelength ranging system and started to track LEO satellites.**

Raman laser

- Pump energy: 40mj (532nm)
  oscillator/amplifier/SHG
- Raman cell length: 1 meter
  18 bar pressurized with hydrogen
  (18-20 bar optimum according to Hamel, Hu
  conversion efficiency experiment result)
- Output beam: 683/532/436nm
  energy: 4mj/10mj/0.4mj
- 683/532 pair was adopted and transmitted
  simultaneously for the experiment



Two/Three Wavelengths Optical Scheme

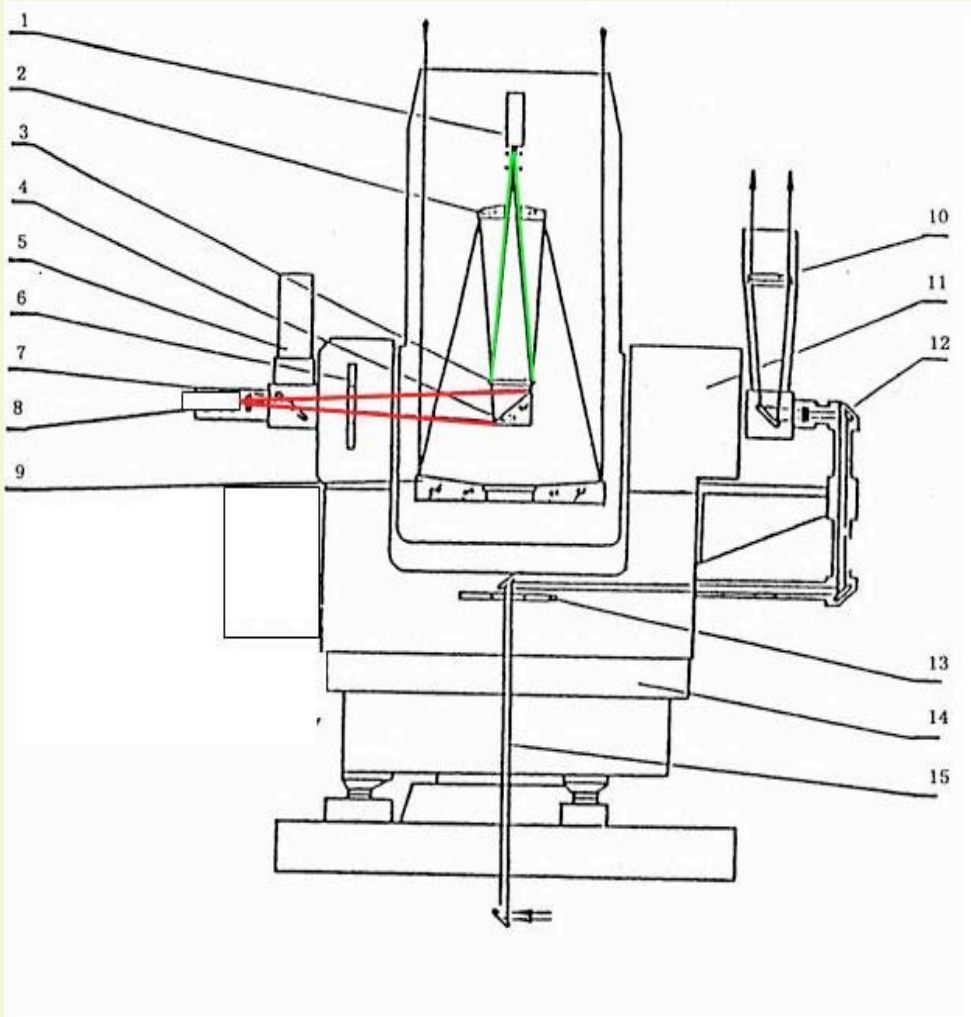


Two-wavelength System Setup

Receiving system

Two SPADs are used to receive signals of red/green color simultaneously.

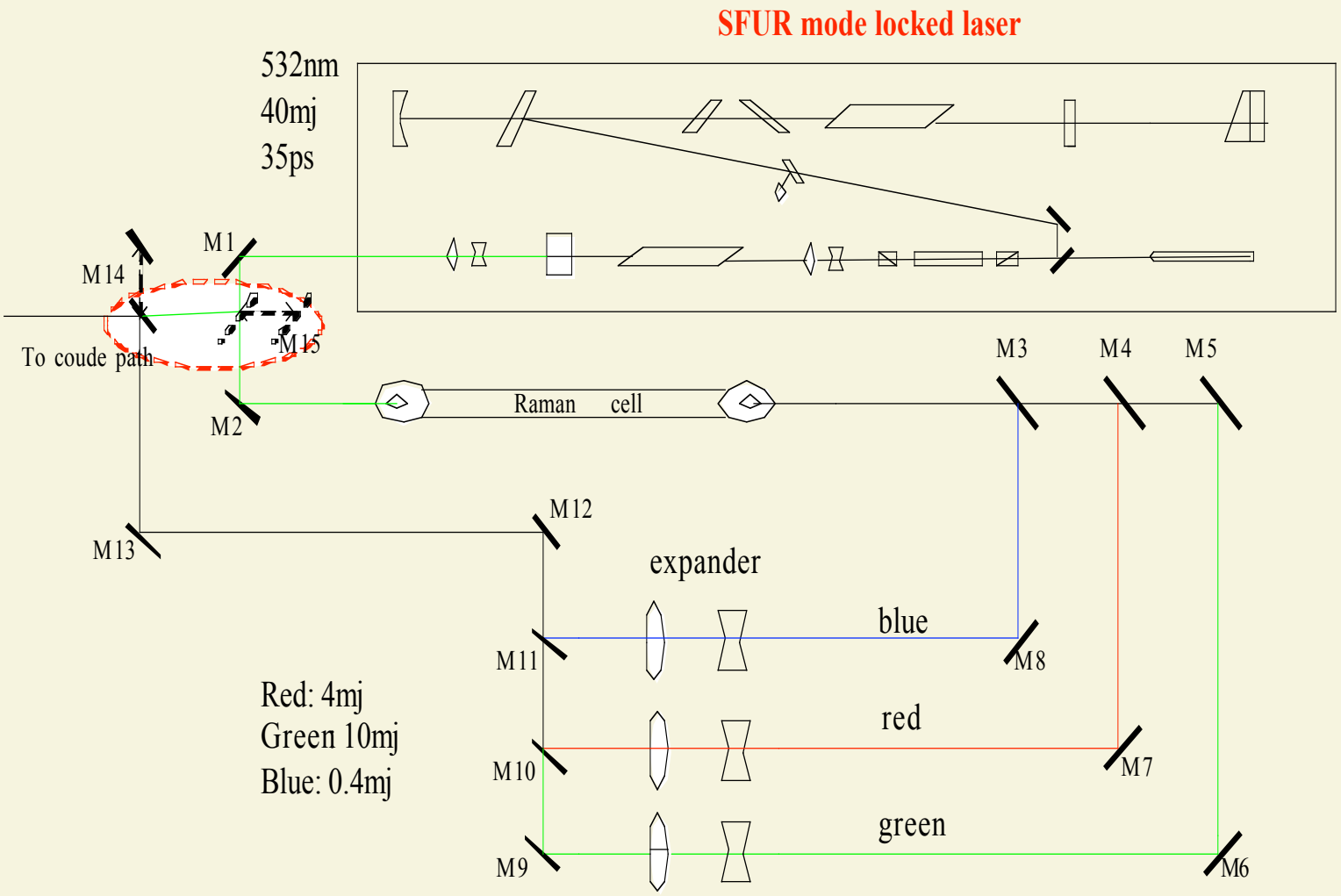
1. SPAD 1
3. dicroic mirror
4. 45 degree bending mirror
5. ICCD camera
8. SPAD 2
9. primary mirror
15. coude path



Two SPADs Installation

Other improvements:

- All mirrors in coude path were recoated for three colors
- Two counters (SR620,HP5370) recorded the two wavelength returns respectively
- Switching between routine ranging and two-wavelength ranging by moving M14 and M15 mirrors
- Range residual (O-C) from both colors display on same display interface of tracking, a fixed range bias was added on the ranges of red color for identifying two color returns easily



Switch between routine ranging and two-wavelength ranging

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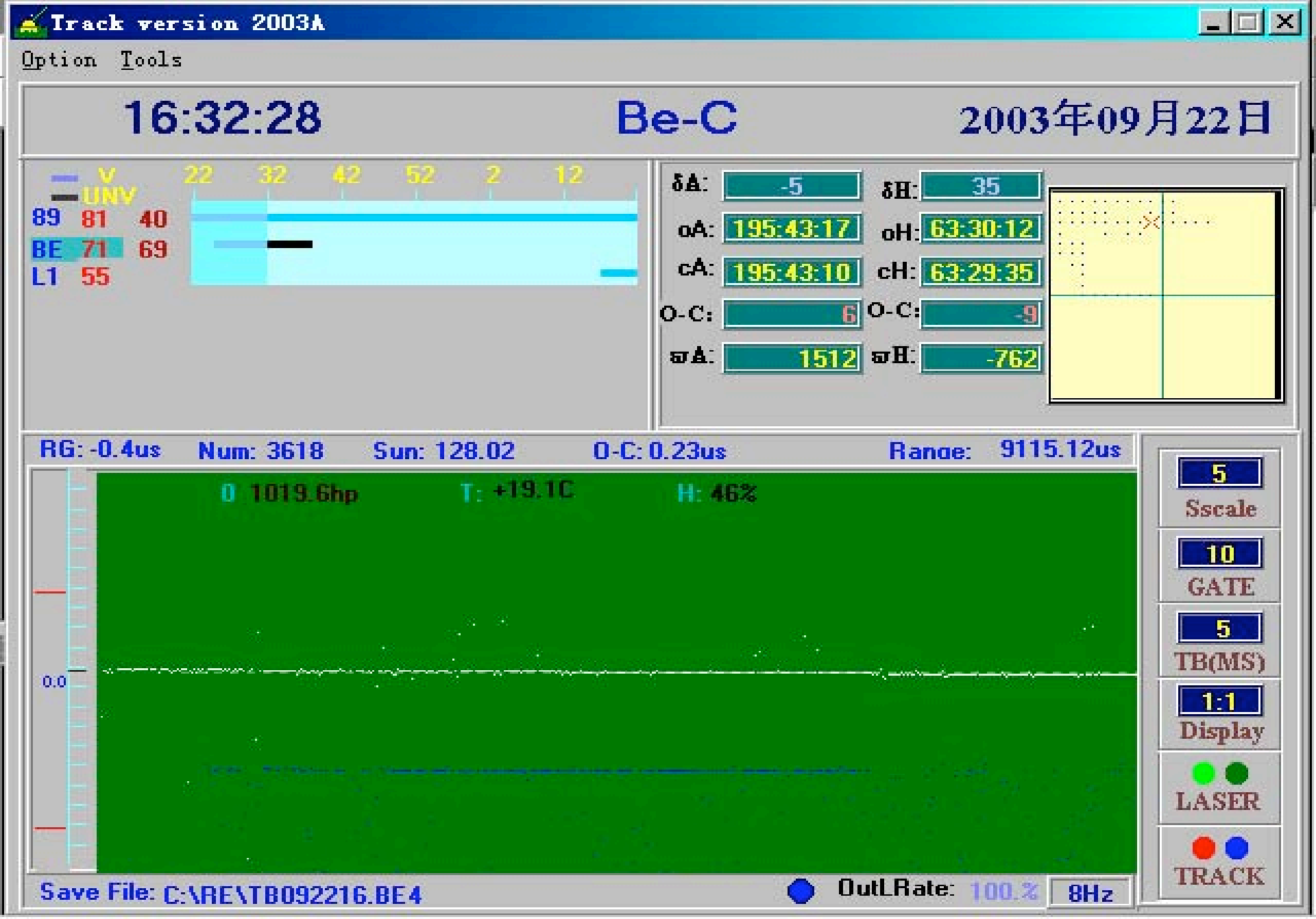
The ranging experiment

- Only low earth orbit satellites were tracked due to low energy of 4mj at 683nm
- Two beams have to be better alignment before experiment
- After test to the near target, we started to range LEO satellites on July 27, 2003
- More than 20 passes were obtained for over two-month experiment (including ERS-2, STARLETTE, TOPEX, JASON, BEC, AJISAI)
- Ranging precision is 0.8-1.2 cm for green color; 1.2-1.5cm for red color after careful adjustment



Real-time Display of BEC Tracking

Conclusion

1. An experimental two-wavelength SLR system with dual-receiving-channel was established at Shanghai station. Some LEO satellites have been tracked with a pair of 532nm/683nm.
2. But the present system has some drawbacks:

- The data from green color mixes with data from red one, it causes difficulty for data preprocessing and degrades the ranging precision.
- Low energy for 683nm and too low energy for 432nm.
- Ranging precision is limited by precision of counters.

Future plans

- Applying the fund to buy counters with high precision
- Improving Raman output energy (683/532nm) for Lageos tracking

Thank you